TERRITORIALITY IN INDIAN BLACKBUCK, *ANTILOPE CERVICAPRA* (LINNAEUS)[1]

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(*With a text-figure*)

Territoriality in blackbuck, *Antilope cervicapra*, was investigated for 2 years in six individually-identified territorial bucks at Mudmal, Andhra Pradesh. A total of 12 territories were maintained by these bucks at different times during the study period. Territory size varied from 3.33 ha to 16.65 ha with a mean size of 9.19 ha. The minimum territorial period was 5 weeks while the maximum was 9.5 months. Some of the bucks shifted their territories abruptly without changing to bachelor status in between. Territories were marked with urination-defecation and with preorbital glands. Interactions of territorial bucks with bachelors showed a higher percentage being directed against adults, due to apparent threat to the territory from them, than from other age groups.

INTRODUCTION

Territorial behaviour by males is one of the fundamental forms of social behaviour exhibited by ungulates (Estes 1974). This social aspect has been well investigated in the wild as well as in captivity in many African antelopes. Studies in the wild on Thomson's Gazelle, *Gazella thomsoni* and Grant's Gazelle *G. granti* (Estes 1967, Walther 1972), Impala, *Aepyceros melampus* (Jarman and Jarman 1974), Sable Antelope, *Hippotragus niger* (Estes 1964, 1969; Estes and Estes 1976); and Springbok, *Antidorcas marsupialis* (Walther 1981) and captive studies on Blackbuck, *Antilope cervicapra* (Hediger 1941, Walther 1959, Mungall 1979); Gerenuk, *Litocranius walleri* (Leuthold 1978); Dorcas Gazelle, *Gazella dorcas* (Walther 1968) and Dama Gazelle, *G. dama* (Mungall 1980) are some of the earlier studies. The species studied so far show some common characteristics relating to territoriality, namely: a) only adult males become territorial, but not all of them, b) usually territorial periods alternate with non-territorial periods during the life of the same individual, c) owners aggressively exclude other males from their territories or at least dominate them within territorial boundaries, and d) usually females only temporarily visit males in their territories (Walther *et al.* 1983). There have been few scientific studies in the wild on this behavioural phenomenon of the Blackbuck. These include studies in Kanha National Park (Schaller 1967) and Velavadar National Park (Ranjitsinh 1982) in India and studies in Texas, U.S.A. (Cary 1976, Mungall 1978, 1979). This paper presents the territory size of six individually identified bucks in the wild at Mudmal, Andhra Pradesh, and aspects related to territoriality.

STUDY AREA AND METHODS

The 80 km^2 study area (*c.*16°24'N, 77°27'E) was divided into 500 x 500 m grids on Survey of India maps scaled 1:33000. Cultivated fields and fallow lands occupied 81% of the area. The remaining 19% area was occupied by 4 different habitat types. These habitat types and utilization have already been described by Prasad and Ramana Rao (1984; in press). Features such as rocky elevations, boulders, grassy patches, rainfed tanks and patches of *Phoenix* sp. in the habitat served as landmarks for identification of grids.

Blackbuck were observed from April 1978 to February 1980. They could be easily approached upto a distance of 100 m, and at times even less, without being disturbed by the observer. By the end of the 2-year study, 11 adult bucks were recognized individually out of a population of 105 animals. Details of the population structure have been given by Prasad (1984). The shape of horns, the number of spirals in horns and the intensity of black colour on the coat were the criteria used in individual identification of bucks. Each buck was assigned an identification code such as PB I, PB II, LIMI, PPR I, etc. Of these, eight were territorial at one time or other. Data on bucks PPR II and PPR III was scanty and is hence not dealt with here.

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TABLE 1
TERRITORY SIZE AND TERRITORIAL PERIOD OF BLACKBUCK AT MUDMAL

Territorial buck	Total sightings	No. of days territorial behaviour seen	Location on Fig. 1	Territorial period (weeks)	Territory size (ha)
PB I	265	13	A	11 Nov 1978-31 Jan 1979 (11)	7.8
		9	B	2 Feb 1979-13 Apr 1979 (10)	13.0
PB II	336	18	C	12 Sep 1978-21 Mar 1979 (26)	12.28
		34	D	25 May 1979-17 Feb 1980 (38)	16.65
PPR I	42	4	E	3 Feb 1979-2 May 1979 (14)	7.80
		5	F	10 Jun 1979-16 Jul 1979 (5)	8.53
LIMI	349	8	G	15 Sep 1978-31 Oct 1978 (7)	5.93
		6	H	4 Nov 1978-27 Dec. 1978 (8)	11.86
		20	I	4 Feb 1979-2 Oct 1979 (34)	10.92
LG III	92	12	J	12 July 1979 -27 Nov 1979 (20)	7.49
PM I	87	8	K	Nov 1978 - 25 Feb 1979 (13)	3.33
		10	L	12 Mar 1979 - 18 May 1979 (10)	5.41

Combined average of all territories: 9.19 ha.

All observations were carried out on foot during daytime and were aided by 8 x 30 and 8 x 40 binoculars. The places at which territorial behaviour was expressed by bucks on different days were identified on gridded maps. The behaviour patterns used for identifying territoriality were: expression of dominance by a buck over conspecifics of the same sex through fights and chases and attempts to drive them from a specified area; vigorous attempts to herd members of the opposite sex within this area; marking the area with urine, faeces, and preorbital gland secretion (Walther *et al.* 1983). The outermost points where territorial behaviour occurred in the study area during the observation period of individual bucks were joined by straight lines to form the boundary of the territory. The area of the territory was determined by tracing the boundary onto a graph paper to appropriate scale.

Dung piles used exclusively by territorial bucks PB I, LIMI, and LG III were identified individually. A paper tag was attached to a bush or a plant near the dung pile. This enabled me to record the visits of the bucks to the dung pile. The dung piles were measured and represented on the map.

A total of 269 days were spent from April 1978 through February 1980 and over 780 hrs. of observations made on the activity patterns of different animals. Observations on territorial bucks totalled 366 hrs. The number of hours of observations varied from 1-10 hrs. per day. The method of data recording was described in detail by Prasad (1985). X^2-test was performed to find seasonal differences in the interaction of territorial bucks with other members.

RESULTS AND DISCUSSION

Territories

The territories of all six bucks were on fairly elevated, open grassland. From these areas, the bucks could have a visibility radius of at least 1 km. This allowed them to see the activities of other blackbuck nearby. Due to the presence of fresh and palatable forage material in these areas and in adjacent cultivated fields and fallow lands they formed centres of blackbuck activity.

Territorial period

The minimum period a buck was observed holding territory was five weeks (PPR I) while the maximum was 9.5 months (PB II; Table 1). Except for LG III, all other bucks changed the location of the territory to a new place at least once. At the beginning of the study, LG III was observed in a bachelor herd and became territorial only during July 1979. Most bucks appeared to shift territories on their own and were not driven from them by another male. LIMI maintained a territory in three different locations at different times (Table 1). On

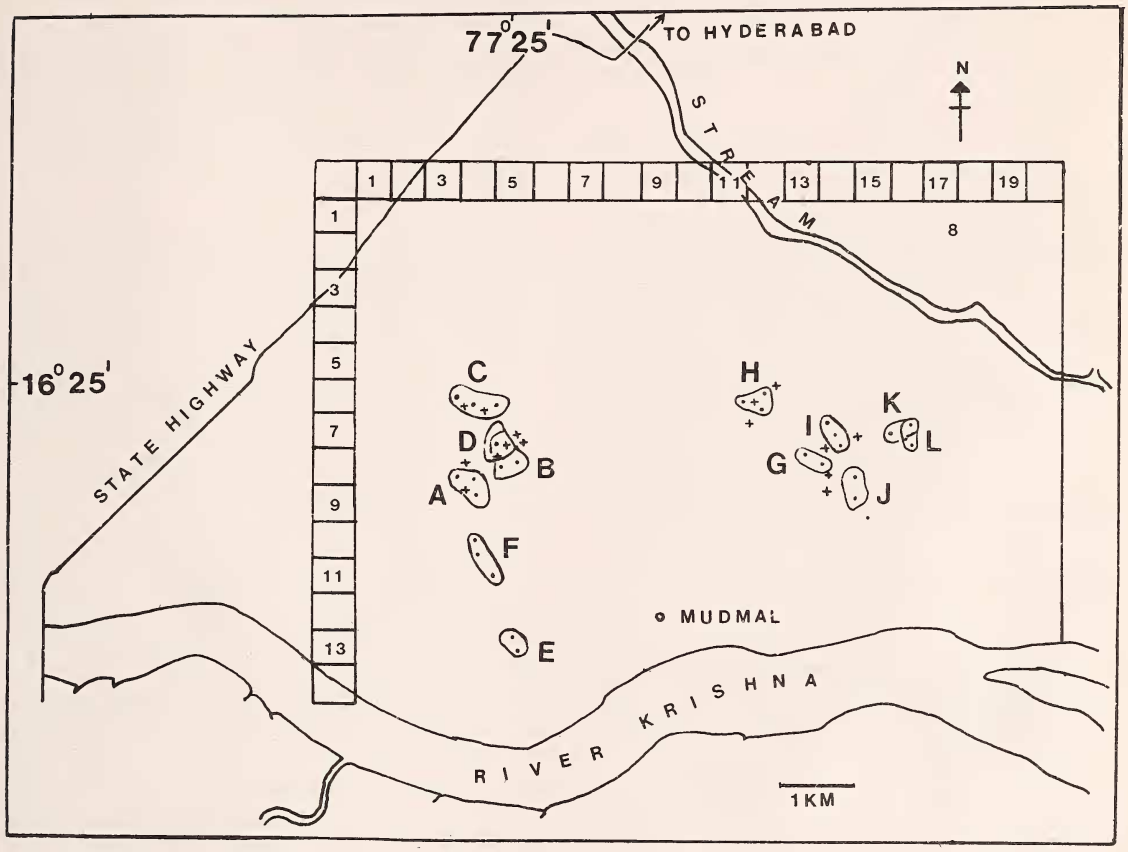

Fig. 1. Distribution of territories of six territorial bucks in Mudmal. A-L: Location of territories at different times (details in Table 1). Dot indicates dung pile location; plus indicates thrashing bushes/preorbital gland marking.

25 February 1979, during the ownership of territory at location I, he was passing near the territory K (PM I) and was seeing limping. He was chased away by PM I while the females accompanying LIMI strayed into territory K. In subsequent observations., LIMI was alone in an adjacent area which was not occupied by any other buck. On 4 April 1979, and later on, LIMI exhibited courtship behaviour within this area. Although he was seen within this territory during November 1979, courtship behaviour was not observed. On 30 December 1979, he joined a bachelor herd and was seen in association with them till 20 February 1980.

PB II changed the location of his territory from C to D on 25 May 1979 after the death of PB I. Part of this newly acquired territory belonged to PB I (Fig. 1). The change of place was mainly due to poor forage quality in the area and a decrease in number of females. On some occasions bucks were temporarily forced out of their territories by cultivators. Bucks returned as soon as the cultivators left the area and defended the same boundaries.

Size and Shape

Territory size varied between 3.33 ha (PM I) and 16.65 ha (PB II; Table 1). The combined average of 12 territories (A-L; Fig. 1) of all bucks was 9.19 ha. PB I, PB II, LIMI and PPR I showed smaller size. The territories were either elliptical or triangular in shape. Boundaries of territories consisted of sheet

rocks, streams, hedges of cultivated fields and uncultivated fields with *Phoenix* trees. These landmarks seem to limit the activity of bucks forming a boundary, which possibly enables them to recognize their territories.

Schaller (1967) reported a territory size of 8.09 ha in Kanha National Park, and Ranjitsinh (1982) measured territories ranging from 28 x 24 m (0.07 ha) to 380 x 290 m (11.02 ha) at Velavadar National Park, India. The size of 33 territories in Texas, USA, ranged between 1.2 and 12.8 ha with an average of 4.1 ha (Mungall 1979). Pasture size and distribution of suitable tracts of open pastures were found to determine the territory size. The largest sizes were 12.8 ha and 11.3 ha in large and small pastures respectively. Mungall (1979) also reported territorial periods ranging between 2 weeks and 11 months with an average of 4 months, which is comparable with the territorial periods at Mudmal.

Behavioural patterns associated with teritoriality

Marking certain areas by urination-defecation and with preorbital glands had special significance in the establishment of blackbuck territorial boundaries. These behaviour patterns, although expressed by any adult buck, were more pronounced in the territorial bucks.

Dung pile

Each buck had at least one dung pile within its territory. The dung piles were located either centrally or near the boundary of the territory. When there were more than two, the distance between them varied from 20 to 100 m. Dung piles were also maintained by non-territorial bachelor bucks outside territories. Dung piles were visited by bucks: 1) after the completion of bedding activity, which is a ritualised behaviour and may help the buck to assure its ownership of the territory, 2) before and after interaction with females and with adult bucks that would try to intrude into the territory, 3) when they were subjected to human disturbance, and 4) whenever they passed near the dung piles during other activities such as feeding. While using a dung pile, the buck approached it, perhaps sniffed, pawed it once or twice with a foreleg, then stood with hind legs stretched rearward and urinated. Later, he squatted and defecated. The whole ceremony lasted between 20 and 38 sec. (X=30.7; n=84). After this the buck usually lay down nearby. The distance from the place of bedding to the nearest dung pile varied between 5 and 150 m. Ranjitsinh (1982) and Mungall (1978), however, have documented many cases of territorial bucks lying directly on the dung pile. At Mudmal, the bucks were never observed to lie on the dung pile itself.

The maximum frequency of visits to a dung pile was two per day (LIMI). Some of the dung piles were not visited for 2 weeks. Their use was restricted to summer and winter. After the onset of monsoon in June, bucks stopped using them. However, territories were maintained by bucks during the rainy season as well. The temporary suspension of dung pile maintenance during the monsoon may be because rains wash off and negate the effect of the scent of the dung piles. Bucks started using them again during the last week of October, establishing a new dung pile very near the old ones. In some cases, however, the previously used ones were re-established. A buck's dung piles may be used by another buck in the absence of the owner. Bucks scraped the dung piles, though either one or both urination and defecation were omitted on certain occasions. This scraping resulted in shallow depressions that were oval or round. The average maximum diameter was 86.5 cm when they were oval (n=16). The mean diameter of dung piles ranged between 53.3 cm and 75.3 cm. (n=29; Table 2). The maximum depth ranged from 8.5-15.0 cm. The depth depends mainly upon the number of visits, duration of use and the soil type in which it is located.

For comparison, Nair (1975) observed dung piles 80 cm long, 20 cm wide and 20 cm deep in Point Calimere; Ranjitsinh (1982) measured piles 2.0 m long and 1.6 m wide; Mungall (1978) reported an average diameter of 1 m (n=72), and when oval a maximum length of 4.7 m (n=66) in Texas, USA.

Marking with preorbital glands

Preorbital gland marking by the territorial bucks was observed only on a few occasions (Fig.1). During preorbital gland marking, bucks thrashed small bushes or tufts of grass vigorously while chasing away the bachelors from their territories. Thrashing of bushes was also observed outside the

TABLE 2
DUNG PILE DATA OF TERRITORIAL BUCKS AT MUDMAL

Territorial buck	No. of dung piles	Diameter (cm)		Depth (cm)	
		Maximum	Average	Maximum	Average
PB I	6	74.0	59.6	13.0	12.0
PB II	4	84.0	57.33	8.5	8.2
PPR I	4	59.0	53.5	9.0	8.3
LIMI	8	86.5	75.3	15.0	12.0
PM I	4	61.2	52.4	11.0	8.6
LG III	3	76.0	60.5	10.0	9.2

territories. Marking with preorbital gland in these areas of bushhorning have not been noticed. Such activities, although less frequent, were also exhibited by non-territorial bucks.

Interactions of territorial bucks with other members

Serious fights between territorial males were very rare. A territorial male would resort to fighting with adults when his challenging threat displays did not drive away the intruder. In most cases the owner of the territory would succeed. A total of 1482 interactions of various types between various sex and age groups were recorded during the study period of which 910 (61.4%) were by territorial males, 260 (17.5%) by adult males, 118 (7.9%) were by adult and subadult females, 106 (7.2%) were by subadult males and the rest by adolescent males and fawns (Table 3). This reveals that territorial bucks are socially more active than others.

Over 900 interactions were observed in which territorial bucks addressed females and males of various age groups (Table 4). Of these, 42.2% were with adult and subadult females, involving pursuit walk, head-up, nose-up displays and other courtship activities. The proportion of interactions with females in three seasons is significantly different ($X^2 = 22.65$; $p < .05$) with a peak in summer. This could be because more females come into heat in this season. Serious fights between territorial neighbours were very few (3.85%). Territorial bucks addressed adult bucks more frequently (27.14%) than bucks of other age groups, apparently due to an immediate threat to their territory. This, however, is not significantly different, nor are there seasonal differences ($X^2 = 5.87$; $p > 0.05$). Interactions in which a territorial buck was an addressee and an adult buck an addressor were only 2.31%. Territorial bucks addressed adolescent bucks more often (16.37%) than subadult bucks (9.56%).

CONCLUSIONS

Blackbuck territories are reproductive territories (Mungall 1978). For maximum reproductive success, a territorial buck should occupy an area that is more frequently used by females. The location of territories in all the cases in the present study agrees with this. Once a buck establishes a territory, he may try to enlarge this area to the extent he can defend the territory against the intrusion of conspecific males.

Bucks shift the location of a territory to a new place when the area currently maintained attracts fewer females due to deteriorating habitat conditions.

A territorial buck faces threat mainly from other adult bucks. Hence he resorts to more frequent encounters with them than with younger males, to keep them off his territory.

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TABLE 3
% INTERACTIONS INVOLVING HEAD-UP, NOSE-UP, BUTTING IN MALES AND FEMALES DURING 1978-80

	ADDRESSEE						
ADDRESSOR	Territorial male	Adult male	Subadult male	Adolescent male	Fawn	Adult & sub-adult female	TOTALS
Territorial male	3.85	27.14	9.56	16.37	0.66	42.42	100 (910)
Adult male	2.31	30.0	16.15	13.08	7.69	30.77	100 (260)
Subadul t	0.0	0.0	59.43	24.53	4.72	11.32	100 (106)
Adolescent male	0.0	0.0	25.93	59.26	14.81	0.0	100 (54)
Fawn	0.0	0.0	0.0	0.0	100.00	0.0	100 (34)
Adult & subadult female	0.0	0.0	0.0	0.0	39.83	60.17	100 (118)

Total interactions are given in parenthesis

TABLE 4
% INTERACTION OF TERRITORIAL BUCKS WITH OTHER BLACKBUCK DURING 1978-80 AT MUDMAL

Season	Territorial buck	Adult bachelor buck	Subadult bachelor buck	Adolescent buck	Fawn subadult female	Adult &	Total
Summer	1.41	28.78	10.85	9.90	0.00	49.06	212
Monsoon	4.81	22.12	10.10	15.14	0.96	46.87	416
Winter	4.26	33.33	7.80	23.05	0.71	30.85	282
Whole year	3.85	27.14	9.56	16.37	0.66	42.42	910

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